^{12}C(^{3}He,^{3}He) 1971St22,1977Bu03

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. H. Kelley, J. E. Purcell and C. G. Sheu	NP A968, 71 (2017)	1-Jan-2017

1966Sc12: ^{12}C(^{3}He,^{3}He) E=2.0-6.1 MeV, measured σ(E,θ).
1966Sc22: ^{12}C(^{3}He,^{3}He) E=8.5-10.0 MeV, measured σ(E,θ).
1968Fo06: ^{12}C(^{3}He,^{3}He),(^{3}He,^{3}He′) E=12-19 MeV, measured σ(E,θ), σ(E,E(^{3}He′),θ). Deduced optical model parameters.
1968La19: ^{12}C(^{3}He,^{3}He)E=5.29-5.50 MeV, measured σ(E,Ep,θ). Deduced optical potentials, level overlap parameter.
1968We15,1969We03,1971Ja01: ^{12}C(^{3}He,^{3}He) E=2.0-8.0 MeV, measured σ(E,E(^{3}He),θ).
1969Ar08: ^{12}C(^{3}He,^{3}He) E=36 MeV, measured σ(θ). Deduced optical model parameters.
1969En03: ^{12}C(^{3}He,^{3}He) E=31.6 MeV, measured polarization P. Deduced optical model spin-orbit potential.
1969Zu02: ^{12}C(^{3}He,^{3}He) E=15 MeV, measured σ(θ).
1970Mc10,1972Mc01: ^{12}C(^{3}He,^{3}He) E=18,20 MeV, measured P(θ), σ(θ). Deduced optical model parameters.
1970Sc23: ^{12}C(^{3}He,^{3}He) E=11.0 MeV, measured σ(θ). Deduced optical-model parameters.
1971St22: ^{12}C(^{3}He,^{3}He′), E=19,19.5,20 MeV; measured σ(E$_{p'}$), σ(^{3}He′). ^{12}C deduced energies of 1st, 2nd excited states.
1973Fu03: ^{12}C(^{3}He,^{3}He),(^{3}He,^{3}He′) E=24.0,29.2,34.7,39.6 MeV, measured σ(E(^{3}He′),θ). Deduced optical model parameters. ^{12}C deduced levels, β.
1973Wi07: ^{12}C(^{3}He,^{3}He) E=217 MeV, measured σ(E(^{3}He),θ). Deduced optical model parameters.
1975Bo06: ^{12}C(^{3}He,^{3}He) E=28 MeV, measured polarization angular distribution. Deduced optical model spin-orbit potential.
1976Ma26: ^{12}C(^{3}He,^{3}He) E=18,20,22,24.5 MeV, measured σ(θ).
1976Ta12: ^{12}C(^{3}He,^{3}He)E=82.1 MeV, measured σ(θ). Deduced optical potential parameters. ^{12}C(^{3}He,^{3}He′) E=81.2 MeV, measured σ(θ). ^{12}C levels deduced β.
1977Ba05: ^{12}C(^{3}He,^{3}He) E=39.1 MeV, measured σ(θ). Deduced optical model parameters.
1977Bu03: ^{12}C(^{3}He,^{3}He′), E=130 MeV; measured σ(E(^{3}He′),θ). ^{12}C deduced giant resonances, deformation length.
1975Bu11,1977Ka25: ^{12}C(pol. ^{3}He,^{3}He) E=20.5-33 MeV, measured σ(θ,E), A(θ,E). Deduced optical model potential, phase shifts, β_2.
1979Go07: ^{12}C(^{3}He,^{3}He) E=44.04 MeV, measured σ(θ).
1980Hy02: ^{12}C(^{3}He,^{3}He) E=119.0 MeV, measured σ(θ). Deduced optical model parameters.
1980Tr02: ^{12}C(^{3}He,^{3}He) E=41 MeV, measured σ(θ).
1982Al14: ^{12}C(^{3}He,^{3}He) E=40.9 MeV, measured σ(θ). Deduced absorptive term characteristics.
1991Go25: ^{12}C(^{3}He,^{3}He) E=98 MeV, measured σ(θ). Deduced model parameters.
1992Ad06: ^{12}C(^{3}He,^{3}He) E=50,60 MeV, measured σ(θ). Deduced model parameters. ^{12}C levels deduced multipole deformation parameters. Optical model and DWBA anaylses.
1995Da08,1995Da21: ^{12}C(^{3}He,^{3}He),(^{3}He,^{3}He′) E=98 MeV, measured σ(θ). Deduced nuclear rainbow effect evidence, model parameters.
1995Ya06: ^{12}C(^{3}He,^{3}He) E=450 MeV, measured σ(θ). Deduced optical potential parameters.
1997Kh07: ^{12}C(^{3}He,^{3}He) E=27.4-217 MeV, analyzed σ(θ). Deduced parameters, reaction σ.
2001Ku20: ^{12}C(^{3}He,^{3}He) E=17-20 MeV/nucleon, analyzed σ(θ). Deduced S-matrix parameters.
2003Ka24: ^{12}C(^{3}He,^{3}He) E=443 MeV, measured σ(θ).
2009Da22: ^{12}C(^{3}He,^{3}He),(^{3}He,^{3}He′) E=34.7,50,60,72,82 MeV, analyzed elastic and inelastic scattering cross section and σ(θ) data using diffraction model of scattering. Deduced nuclear rms radii for excited states in ^{12}C.
2013Ha01: XUNDL dataset compiled by TUNL, 2013.
Beams of 50.5 and 60 MeV ^{3}He ions from the Almaty-Kazakhstan U-150M cyclotron impinged on a 30 μg/cm^{2} and the angular distribution of scattered ions was measured for 15°<$\theta_{c.m.}$<170° by a set of four moveable ΔE-E Si telescopes. Angular distributions were analyzed using a coupled channels method and the location of the Airy minimum was deduced. Analysis of scattering to the Hoyle state suggests it is a 3α particle condensate with a large radius of dilute matter.
2014Wh02: XUNDL dataset compiled by TUNL, 2014.
Unbound ^{12}C states were studied using 46 MeV ^{3}He ions, from the Birmingham MC40 cyclotron, that impinged on a 300 μg/cm^{2} carbon target. The scattered ^{3}He ejectiles were detected using a position sensitive ΔE-E Si-strip detector telescope that was placed 9.8 cm from the target at θ_{lab}=−32.5°. Additional details on the reaction were determined by measurement of α-particles from the breakup of recoiling ^{12}C. The α-particles were detected in an array of 2 ΔE-E Si-strip telescopes placed at θ_{lab}=27.5° and 57.5°. The data were analyzed with a kinematic gate that required a sequential decay via ^{12}C→^{8}Be$_{g.s.}$+α_0. This implies only states with

^{12}C(^{3}He,^{3}He) 1971St22,1977Bu03 (continued)

natural parity were selected. Discussion on backgrounds and contaminant reactions, such as ^{12}C(^{3}He,^{7}Be→^{3}He+α) and ^{12}C(^{3}He,^{11}C→^{8}Be+^{3}He) are given in the text.

The known states at E_x=7.65, 9.64, 10.84 and 14.08 were easily resolved with an experimental resolution of ≈530 keV. A variety of states up to E_x=25.1 MeV are observed and compared with literature values. By comparing the ^{3}He "singles" rate with the ^{12}C→^{8}Be$_{g.s.}$+α_0 data, the authors estimated the $\Gamma_{\alpha 0}/\Gamma$ branching ratios for several states.

1980Le25: Unconfirmed $J^{\pi}=0^{+}$ states are reported at 9.25 MeV *20* (Γ=1.8 MeV *2*) and 20.3 MeV *2* (Γ=1.1 MeV *2*).

^{12}C Levels

E(level)	J^{π}	Γ	L	Comments
0			0	
4442.2 *15*			2	E(level): From (1971St22).
7655.9 *25*				E(level): From (1971St22: includes (p,p′)). $R_{r.m.s.}$≈2.94 fm (2008De35).
9.6×10^{3}			3	
10.83×10^{3}				
10.84×10^{3}				
12.7×10^{3}			0	
14.08×10^{3}				$\Gamma\alpha_0/\Gamma$=0.20 *10* (2014Wh02).
15.11×10^{3}			0	T=1 $\Gamma\alpha_0/\Gamma$<0.08 (2014Wh02).
15.2×10^{3} *3*		1.8 MeV *3*	2	E(level),Γ: From (1977Bu03).
16.11×10^{3}			2	T=1 $\Gamma\alpha_0/\Gamma$=0.18 *10* (2014Wh02).
16.58×10^{3}				T=1
18.4×10^{3} *6*	3^{-}	0.4 MeV *1*	2	T=1 E(level),Γ: From (1977Bu03). $\Gamma\alpha_0/\Gamma$=0.25 *10* (2014Wh02). J^{π}: From (2014Wh02).
18.90×10^{3} *15*		0.70 MeV *15*	2	T=1 E(level),Γ: From (1977Bu03).
19.58×10^{3} *6*				T=1 E(level),Γ: From (1969Ba06). $\Gamma\alpha_0/\Gamma$=0.21 *10* (2014Wh02).
21.30×10^{3} *15*		1.4 MeV *2*	2	E(level),Γ: From (1977Bu03). Possibly unresolved states with Γ=1.4 MeV *2* and Γ=0.43 MeV *8*.
22.2×10^{3} *3*		<0.7 MeV		E(level): From (2014Wh02). This state can likely be associated with the E_x=22.4 MeV $J^{\pi}=5^{-}$ state that was populated in ^{12}C(α,3α) (2014Ma37).
23.5×10^{3} *2*		0.6 MeV *2*	2	E(level),Γ: From (1977Bu03).
25.1×10^{3} *3*		<0.8 MeV		E(level): From (2014Wh02).
25.9×10^{3} *3*		2.2 MeV *3*	2	E(level),Γ: From (1977Bu03).
28.8×10^{3} *4*		2.7 MeV *4*	2	E(level),Γ: From (1977Bu03).